Grounds

How To Find A Ground For Your Equipment

Setting up your station for the first time? Here's an article that will tell you how to ground your equipment, why a ground is needed, and other pertinent information.

BY LEWIS G. McCOY,* W1ICP

One of the first problems a novice or newcomer runs into in ham radio is that of grounding. Should a receiver or transmitter have a ground connection for better operation? Can they be operated without a ground, and if so, do they work just as well? What about getting lightning protection for the equipment by grounding?

In dealing with electrical circuits, it is very important that we have a common reference point. The best reference point would be one that is least likely to change and is common to every circuit. There cannot be much doubt that the only reference point that fits these requirements is the earth itself. No matter what we do to the earth (at least so far), it is impossible to change its electrical potential. Because of this fact, the earth is used as a basic reference point in dealing with electrical or radio circuits. The electrical symbol for an earth connection is shown at Fig. 1A.

When we connect something to earth, and say that the "something" is at ground potential, we mean there is no voltage difference between the two. In wiring electrical gear or radio equipment there is usually a common connection point — our reference point — and this is usually referred to as "chassis ground" or the "ground bus." The chassis ground could be connected directly to earth ground and there would be no difference in potential. The circuit symbol for a chassis ground connection is shown in Fig. 1B.

Many newcomers to reading circuit diagrams think that there is some special lead or connection to tie all of the chassis ground connections together, but it is simply the chassis itself, if the chassis is metal, or a ground bus or lead if the chassis is made of nonconducting material.

Also, many novices assume that the chassis of a receiver or transmitter must be connected to earth ground in order for the equipment to work properly. This is an incorrect assumption. As we can see, if both the piece of gear and the earth are at the same potential, it doesn't make any difference whether they are connected together or not. They *can* be, but they don't *have* to be.

However, there is another reason for connecting all the chassis in your station to a good earth ground, and it is a very important reason: *safety*. While it isn't a common occurrence, it is always possible for a component to fail in a piece of equipment, with the result that the chassis may be at a different potential from the earth, or different from the potential of another chassis in the station. If you should touch both chassis at the same time or touch something connected to earth and the chassis with the voltage difference on it, you'll get an electrical shock, and this can be very dangerous.

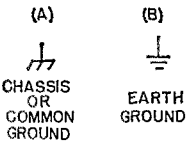


Fig. 1—The symbol at A is the one used to indicate a common or chassis ground. At B is the symbol indicating a connection to an earth ground.

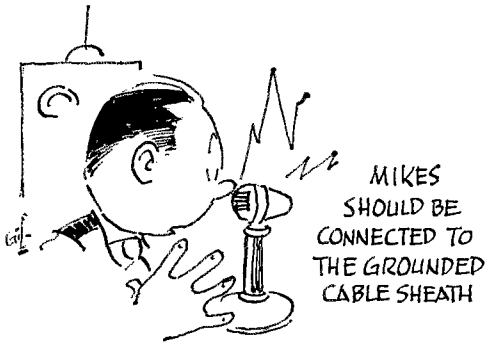
By having all the chassis in the station connected to ground, a component failure will cause the fuse in the faulty equipment to blow—assuming, of course, that the equipment was fused, and it *should* be.

If it isn't fused, more than likely something would heat up to the point where you would notice the failure and turn off the power. But most important, you wouldn't get a shock by touching the faulty equipment.

Earth-Ground Connections

Naturally, the first question asked would be, "What is a good earth-ground connection?" For years, the word among hams was that water pipes make good earth-ground connections. While a water pipe *can* be an excellent ground,

* Novice Editor.



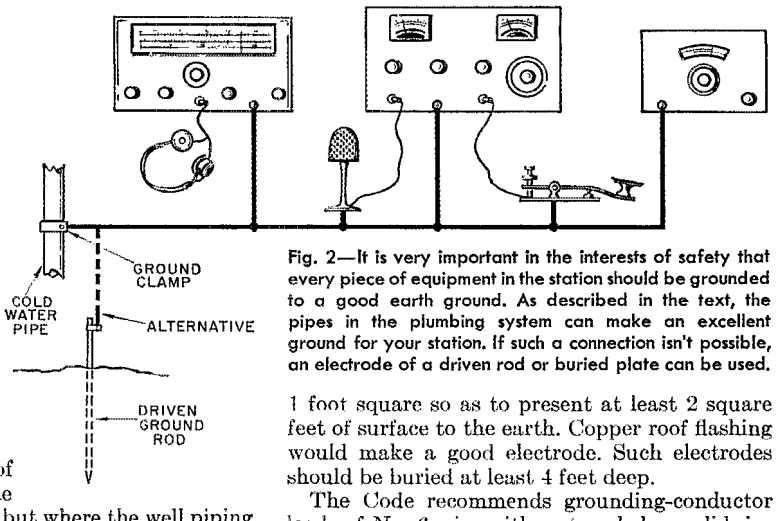


Fig. 2—It is very important in the interests of safety that every piece of equipment in the station should be grounded to a good earth ground. As described in the text, the pipes in the plumbing system can make an excellent ground for your station. If such a connection isn't possible, an electrode of a driven rod or buried plate can be used.

any fairly recent plumbing installation should be carefully checked. In the author's case, a deep well is used to supply water. All of the plumbing in the house is copper tubing, but where the well piping enters the house through the basement wall plastic tubing is used. And plastic "just ain't" a good conductor. In many of the newer housing developments plastic type pipes or couplings are used, so an amateur planning to use a water pipe ground would do well to check that metal piping is used all the way to where it enters the earth. Make sure that metal connectors or unions are used. If the piping is metal and is complete to the earth, the piping makes an excellent ground connection point.

The power companies always use a "neutral" or ground connection when they bring the a.c. lines into a dwelling. You will always find a connection to earth ground at the power service entrance. In locations where water pipes are available, the power company makes its ground connections to the water lines. In installations where no water lines are available the ground electrode is usually a ⅝-inch diameter rod, 8 feet long, and made from a nonferrous metal, usually copper. You can make your earth-ground connection to this same point.

The National Electrical Code lists several types of grounding electrodes that can be used to obtain an approved earth ground. The electrode can be a driven pipe, driven rod, or a buried plate. A driven pipe should be at least ¾ inch in diameter, 8 feet long, and have the outer surface galvanized or otherwise metal-coated to reduce corrosion. Buried plates must be at least 1 foot square so as to present at least 2 square feet of surface to the earth. Copper roof flashing would make a good electrode. Such electrodes should be buried at least 4 feet deep.

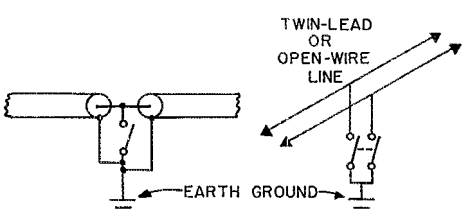
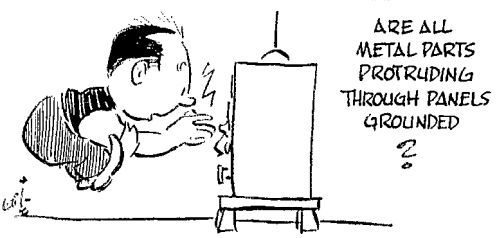


Fig. 3—Method of grounding either coaxial lines or parallel feeders for station lightning protection. T-style coax fittings are available and can be used for coax lines.

The Code recommends grounding-conductor leads of No. 6 wire, either stranded or solid, insulated or uninsulated. Any electrical contractor or supply house stocks both electrodes and conductors. We don't recommend using TV-type ground rods simply because these usually are steel rods with a thin copper coating which tends to rust off a few days after the rod is installed. Use approved type of equipment; it will pay off in the long run.

In the author's station, which is located in the basement, a ground electrode was driven into the earth just outside the basement wall. A lead was brought in from the electrode and connected to a length of ¼-inch diameter copper tubing



which was mounted along the rear of the operating desk. All the equipment in the station is connected to the tubing. In addition, a connection was made from the tubing to the neutral side of the a.c. line to make sure that the newly installed ground was at the same potential as the a.c. ground. The two grounds are about 50 feet apart, and it could be possible to have enough resistance in the earth between them to have a slight potential difference. If possible, when installing a separate ground electrode connect it to the a.c. ground to avoid any potential differences that may exist.

Grounds and Apartment Buildings

Concrete or stone apartment buildings can present a problem in obtaining an earth-ground. Concrete and stone are *not* conductors. Water pipes may provide a ground but this isn't always a sure thing, as pointed out earlier.

(Continued on page 158)

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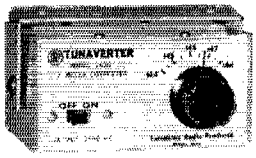

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K4GRD	DJ6NE	HK3SO	WA4LMD	W7HO	W8ZVL/-	WA1CXE	
K5OLJ	DJ9QO	I1BBR	WA4MDA	W7RPH	6	W2PBZ	
K8GQG	DL6ZT	I1PAI	WA4WLX	WA8GRO	W7LEB	WA2CCF	
OE1WP	F2VX	I1PIE	W6ZGZ	W9UX	W8PQD	WA2LMW	
OK3KAB	F8SA	IS1TDW	WB6ABL	YV1KZ	W9PVZ	WA2RUB	
VK3KB	I1APV	K1QMV	WB6OYM		WA9MOB	WA2WFI	
W2DY	K4UOQ	K1ZQL	W7REZ		ZD8JC	WB2ICS	
WB2QKT	K5DZV	K4MKI	W8IBX	**101**		WB2OBO	
WB6FCR	K9TXZ	K5TOK	WA8MQP	CR7FM		W4AYL	
WB6LQR	KG6SB	OE1IU	W9GFF	CT1MW	**100**	W4BCB	
W7WS	VQ8AR	VE3LZ	WA9BVX	DJ6FN	CN8AQ	WA4BRW	
YA5RG	WB2PPP	VP7DR	W9JWD	DJ9XA	CP5AD	WA4CQN	
	W5LXX	W3ZPO	YV5CHO	DL3LS	CR4BC	WA4OQO	
108	W6UQU	W4HVD	ZS6AUZ	F7CK	DJ6OK	WA4RQD	
DJ1YL	WA6HKG	W6OMR	9K2AN	G3NXB	DJ6VH	WA4SWW	
DJ8YQ	WB6JRL	WB6RMZ		G3PFE	DL2AH	WA4TLI	
HA5AM	W8TWA	W8WAH		HB9VJ	DL3RE	WB4BKV	
K1ZUP	WA8LYJ	W9HGA	**102**	HK3AUE	DL6XV	WA3APO	
K5JCC	W6CQT	WØLHP	AP2MI	I1ERE	DL9DE	/4	
K6SVQ	XE1XS	WAØIHQ	CT1NL	I1MY	DL9XR	W6MR-	
K9PQG	ZE1BP	5R8AK	DJ4ZD	I1WL	F2QM	U/4	
OZ5GT			DJ9MW	K3FNW	F5SJ	W5DRQ	
UA3CT	**105**		HC6GM	K4BWZ	G3RHM	W5HUM	
WA1BQS	DJ2MV	**103**	HM2BD	K4DJW	G3SVH	W5MIR	
W2EYJ	HK5ACI	CE6EW	I1POB	K5AAD	G5ABA	WA5CST	
WB2VEG	I1FBI	DJ8OT	JA8NU	K7UXS	HK3AJV	WA5NQJ	
WA4ICB	I1TRV	DM2AEC	K1HBM	K8YRN	HK5DE	W6KOE	
WA4UHK	K2MVW	F2EX	K2DJD	K9VLE	K2HLK	W6ORC	
WB6ADY	K6YUI	F2RK	K3CBW	KØHUU	K2HWB	WB6POP	
WØJQQ	KØSPH	K1MKH	K3MLR	KH6FNV	K2PKH	W7ANW	
	KR6DB	K2CHS	KH6FRO	KH6FQB	K2PZF	W7HLH	
107	KZ5AG	K2HPZ	KP4COX	LA4VG	K3ZNS	W7UTL	
DJ3HC	OD5CA	K3TVU	LA1ZI	UA1TT	K4KZZ	W7UZE	
DJ9WA	UA4CZ	LU2FAO	SV0WG	VE3DVT	K4THA	W7ZPV	
HR1KS	W1LEL	OE2UE	TI2KR	VE6AET	K5YBB	W8GHN	
JA2APA	W3BYQ	OE3SAA	VE3AHQ	VP2AC	K7MJC	WA8NDE	
JA4ZA	W4WHP	SM5ZO	VE6PL	VS9AWR	K7TCL	WA8PKG	
JA7BSD	W6CUF	UA1CX	W1DHL	W1DAY	K7ZKH	WA8RSL	
K2MPS	WB6CCV	UA1ZF	WA1BJY	W1MX	K8QYA	W9CCK	
K3TRZ	WB6CGA	VE3FCR	W2ORA	K6HWC/-	K8TBQ	W9FPM	
K3ZCA	K7IIU/6	VE6ABR	WA2YFB	1	K8ZNC	W9OFO	
K9YWY	W7KOI	VP2AA	WB2QKG	W2QIS	K9AXS	WA9NKN	
KX6DR	W8CEM	W1EED	W3ABT	W2UFT	K9FVR	WA9PZU	
OK3DG	W8JSU	W1HQV	W3GVD	WB2FBN	W6IBU/	WA6HMP	
PY2OY	W9MZP	W1MP	W4DFK	WB2KTO	KG6	XE1BC	
W2SJM	WØRRW	W2ONK	W4MLF	WB2RKH	KR6MF	W2ZIA/-	
WA5RQA	ZP5IT	W2ZGB	W4QBY	W3FWI	KX6BW	ZK1	
W6OSU		WB2VZW	W4TZT	W4RMT	OA4EE	ZS6XP	
WB6UJO	**104**	WA3BHY	W5YKF	W4ZDK	OA4PI	3C5FO	
W8LXU	DJ1VY	W4FPQ	WA5KBJ	WA4EKF	PAØPOB	9M2JJ	

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The League Headquarters building is open to visitors Monday through Friday, 8:30 to 4:30, on a "drop-in" basis, and at other times by appointment. The headquarters is on Main Street (Conn. Route 176 and 176-A) about a mile north of the center of town, and about 3 miles west of Conn. 15-U. S. 5, the Wilbur Cross Highway. (For W1AW visiting hours, see the schedule on page 100).

Grounds

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If the building is wired according the National Wiring Code one side of the a.c. line *and* the metal receptacle boxes are at ground potential. It is an easy matter to check the metal boxes by removing the receptacle cover and to see if there is a connection from the a.c. wiring.

If you have a volt meter, you can use it to determine whether the water pipes are at ground potential. Set the meter on the a.c. scale that will read 117 volts, connect one lead to the water pipe and touch the other lead to either of a.c. outlet holes. If one side reads 117 volts you can safely assume that the water system is grounded. The other side shouldn't read anything because, as we mentioned earlier, this is the neutral or ground side of the a.c. line.

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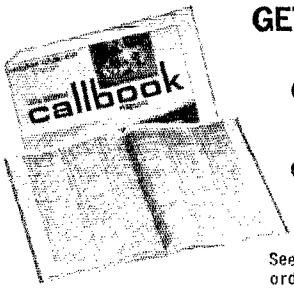
radio amateur callbook



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(*Continued from page 158*)

Also, if you can get contact with the metal frame of the building, the frame is usually at ground potential. You can check this also with your voltmeter.

Lightning and Grounding

Still another good reason for grounding equipment is for lightning protection. First, let's make one point clear that many hams have a misunderstanding about; an amateur antenna is no more of an attraction for *direct* lightning strokes than any other object at the same height in the vicinity. However, an ungrounded antenna system can pick up a sizeable electrical charge from any nearby electrical storm. This can damage equipment, particularly the front end of a receiver, so the feeders should be grounded whenever a storm is in the area. Fig. 3 shows a simple method for grounding either coax or balanced feeders. An inexpensive knife switch can be used for this purpose, and as long as the leads from the switch contacts to the feeders are no more than an inch or so long, the switch won't upset the normal operation of the feeders. Don't forget to open the switch when using the station; otherwise you won't be likely to work out!

Safety

When installing a new piece of gear, the *first* thing to install is the ground connection; when removing equipment, the ground connection should be the *last* connection removed. *Always* keep in mind that electricity can be dangerous. You don't need to be afraid of it, but by all means maintain a healthy respect for any voltage, no matter how small.

As stated at the beginning of the article, you can operate your equipment without grounds, and many amateurs may have to do so because of their station location. However, if it is possible, install a ground system for safety's sake. QST

I.A.R.U. News

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